

## SELECTABLE AUDIO OUTPUT CONFIGURATION

### CROSS REFERENCE TO RELATED APPLICATION

This application claims priority to and all benefits accruing from a  
5 provisional application filed in the United States Patent and Trademark Office  
on January 23, 2004, and there assigned serial number 60/538,563.

### BACKGROUND OF THE INVENTION

#### Field of the Invention

The present invention generally relates to selecting an audio output  
10 from one or more external audio inputs in an audio/video apparatus, in  
particularly, during a standby mode or power-off mode.

#### Background Information

In a home environment, a user may connect several auxiliary  
audio/video devices, such as DVD (Digital Versatile Disc) players, set-top  
15 boxes, CD (Compact Disc) players, MP3 players, and karaoke machines, to a  
main audio/video device, such as a television apparatus, which then  
connected to a hi-fi amplifier. This way, all the audio/video devices can share  
the same hi-fi amplifier.

A disadvantage of the above configuration is that the television  
20 apparatus can select one of the audio input signals to be connected to the hi-fi  
amplifier when the television apparatus is turned on, but is unable to make  
such a selection, when the television apparatus is turned off or unplugged.  
Thus, even if a user wants to enjoy only the audio from one of the auxiliary  
audio/video apparatuses without concerning the video, the user may still have  
25 to perform one of the following. First, the user may have to turn on the  
television apparatus 10, but that constitutes waste of energy because the user  
is not watching the video. Second, the user may remove the audio output of  
the desired auxiliary audio/video device from the television apparatus and  
reconnect the output to the hi-fi amplifier, but that is troublesome because the  
30 user has to move the connection cables back and forth. Finally, instead of  
connecting audio outputs of the auxiliary audio/video devices to the television  
apparatus, the user may connect the audio output of each of the auxiliary  
audio/video devices to an input of the hi-fi amplifier, but that is inconvenient  
because the outputs of an auxiliary audio/video device would have to go to

two different apparatuses: the audio to the hi-fi amplifier and the video to the television apparatus, making the connection arrangement unnecessarily complicated. As such, there is a need to have a television apparatus having the ability to connect one of the auxiliary audio inputs to an audio output of the television apparatus when the television apparatus is turned off, but without significantly increasing the cost of the television apparatus.

### SUMMARY OF THE INVENTION

In accordance with an aspect of the present invention, an audio/video apparatus includes first and second audio inputs for receiving respective first and second audio signals, an audio output, and a switch arrangement for selecting one of the two audio inputs. The audio/video device operates in two modes. In the first mode, the switch arrangement selects one of the two inputs and a broadcast audio signal in response to a user command, and in the second mode, the switch arrangement selects a pre-determined one of the two input audio signals.

In the first mode, the audio/video apparatus is turned on, and in the second mode, the audio/video apparatus is either turned off or unplugged. The audio/video apparatus, illustratively, is a television apparatus.

Another embodiment of the invention is an audio/video system including an audio/video apparatus as stated above but with only one audio input, and an audio amplifier is coupled to the output of the audio/video apparatus, wherein, in a first mode of operation, the switch arrangement selects one of the input audio signal and an broadcast signal for output in response to a user request, and in the second mode of operation, the switch arrangement selects the audio input.

### BRIEF DESCRIPTION OF THE DRAWINGS

The above-mentioned and other features and advantages of this invention, and the manner of attaining them, will become more apparent and the invention will be better understood by reference to the following description of embodiments of the invention taken in conjunction with the accompanying drawings, wherein:

FIG. 1 is an exemplary audio/video system suitable for implementing the present invention;

FIG. 2 is an exemplary embodiment of the television apparatus shown in FIG. 1;

FIG. 3 is an exemplary embodiment of the second audio switch arrangement shown in FIG. 2;

5        FIG. 4 is another exemplary embodiment of the second audio switch arrangement shown in FIG. 2;

FIG. 5 is yet another exemplary embodiment of the second audio switch arrangement shown in FIG. 2; and

10        FIG. 6 is another exemplary embodiment of the television apparatus shown in FIG. 2 but without the second audio switch arrangement.

The exemplifications set out herein illustrate preferred embodiments of the invention, and such exemplifications are not to be construed as limiting the scope of the invention in any manner.

15        Corresponding reference characters indicate corresponding parts throughout the several views. Although the drawings represent embodiments of the invention, the drawings are not necessarily to scale and certain features may be exaggerated in order to better illustrate and explain the invention. The exemplifications set out herein illustrate various embodiments of the invention, but such exemplifications are not to be construed as limiting the  
20        scope of the invention in any manner.

### DETAILED DESCRIPTION

FIG. 1 shows an example of an audio/video system 1 according to the principles of the invention. The system 1 includes an audio/video apparatus such as but not limited to a television apparatus 10, a hi-fi amplifier 15, a left  
25        loudspeaker 190, a right loudspeaker 195, and three auxiliary audio/video devices 11-13: a DVD (Digital Versatile Disc) player 11, a set-up box (STB) 12, and an auxiliary audio/video device 13, which may be a karaoke machine.

The television apparatus 10 includes three audio/video inputs: one (AUX1) from the DVD player 11, one (AUX2) from the set-top box 12, and the  
30        other (AUX3) from auxiliary equipment 11. In addition, the television apparatus 10 also includes an antenna 14 for receiving a broadcast audio/video signal, the audio portion of which should be conventionally processed to produce a baseband audio signal that is acceptable to the hi-fi amplifier 15. The television apparatus 10 includes an audio output coupled to

an input of the hi-fi amplifier 15, which outputs left and right audio signals to drive the left and right loudspeakers 190 and 195, respectively. Although three auxiliary audio/video inputs are shown, the television apparatus 10 may have any number of audio/video inputs.

5       The television apparatus 10 has two modes of operation. In the first mode of operation, the television apparatus 10 selects one of the audio signals from the audio/video apparatuses 11-13 and the processed broadcast audio signal, and outputs the selected audio/video signals via the audio output in response to a user command. The video signal, of course, is displayed in a  
10   display device, which can be integrated into the television apparatus 10, as shown, or a device separated from the television apparatus 10. The selected audio signal is then coupled to the hi-fi amplifier 15. In the following discussion, only the audio switching is described to highlight the situation that a user is only interested in audio.

15       According to the principles of the invention, in the second mode of operation, the television apparatus selects a predefined one of the audio inputs from the audio/video apparatus 11-13, regardless of user entered commands.

      Illustratively, the first mode of operation is the mode, in which the  
20   television apparatus 10 is turned on, and the second mode of the operation is the mode, in which the television apparatus 10 has been turned off. When the television apparatus is turned on, all circuitries in the television apparatus 10 derive power from a main power supply. When the television apparatus is turned off, the television apparatus 10 may be still connected to an external  
25   power source. In this case, although the main power supply is not available, a standby power is still available to a processor of the television apparatus 10, so that the processor can detect a power-on or power-toggle control signal and turns on the television apparatus 10 in response to a user command. However, the standby power is not available to other circuitries in the  
30   television apparatus 10. If the television apparatus is turned off and is unplugged from an external power supply, both main power and standby power are not available to all circuitries in the television apparatus 10. For simplicity, the main power supply, the standby power supply, the external power source, and the processor are not shown in FIG. 1.

According to the principles of the invention, in the second mode of operation, whether the standby power is available or not, the television apparatus 10 selects a predetermined one of the audio signals from the audio/video apparatus 11-13 for output to the hi-fi amplifier 15.

5        FIG. 2 shows an illustrative embodiment of the television apparatus 10 shown in FIG 1. The television apparatus 10 includes a controller 100 for receiving user-entered control signals from a local keyboard 105 and from an infrared (IR) receiver 110. The IR receiver 110 receives and decodes remote control signals transmitted by a remote control unit 115. The controller 100,  
10        which may be a microprocessor or microcomputer, causes a television tuner 120 to select a particular RF signal to be tuned in response to data entered by a user. The tuner 120 produces a signal at an intermediate frequency (IF) and applies it to a processing unit 125 comprising a first section 125a including a picture (PIX) amplifying stage and video detector, and a second  
15        section 125b including, a sound amplifying stage, an audio detector and a stereo decoder. The processing unit 125 produces a baseband video signal (TV), and baseband left and right audio signals.

      The baseband video signal (TV) is coupled via line 126 to one input of a four input video switch 130. The baseband left and right audio signals are  
20        applied to one pair of inputs of an audio switch 140 capable of selecting a pair of inputs from four pairs of audio inputs. The video switch 130 and the audio switch 140 each have three other inputs labeled AUX1, AUX2 and AUX3, for receiving respective baseband video and audio signals from external sources. Each of the inputs of video switch 130 and audio switch 140 is selectable in  
25        response to binary signals generated by controller 100 and applied to control inputs  $C_1$  and  $C_0$  via conductors 131 and 132, respectively. For example, if  $C_1$  and  $C_0$  are both caused to be at a low signal level (i.e. binary 00), then the TV input is selected. If  $C_1$  is low and  $C_0$  high (binary 01), then AUX1 is selected. If  $C_1$  is high and  $C_0$  low (binary 10), then AUX2 is selected. If both  $C_1$  and  $C_0$   
30        are high (binary 11), then AUX3 is selected. The selection of corresponding video and audio signals is ensured because the control lines 231 and 232 are coupled to respective control inputs  $C_1$  and  $C_0$  of both video switch 130 and audio switch 140.

The selected video signal is applied to a comb filter unit 150 which separates luminance (Y) signals and chrominance (C) signals for application to a video processor unit 160 for ultimate display on a display screen of a display device 170. The selected audio signals are applied to a second audio switch arrangement 180.

The second audio switch arrangement 180 illustratively includes four inputs: one from the output of the audio switch 140, and the other three respectively from AUX1, AUX2, and AUX3. The switch arrangement 180 selects one of the four inputs and the selected audio signal is ultimately reproduced via the speakers 190 and 195 through the hi-fi amplifier 15 (not shown in FIG. 2). The selected audio signal may also be coupled to internal speakers (not shown). Although all three inputs from AUX1, AUX2, and AUX3 are shown to be coupled to the second switch arrangement 180, other arrangements are possible. For example, a manufacturer may choose to couple only one or two of the three auxiliary audio inputs to the second audio arrangement 180 for cost saving or other purposes.

The television apparatus 10 also includes a main power supply 101 for supplying main power and a standby power supply 102 for supplying standby power, both deriving power from an external power source (not shown), such as a 110-volt AC power source. The main power is available to all circuitries in the television apparatus 10. The standby power is available to a few circuitries in the television apparatus 10, such as the controller 100 and IR receiver 110, to save energy. For simplicity the connection of the main power to other circuitries in the television apparatus 10 is not shown in FIG. 2.

In the first mode of operation, both the main and standby power supplies provide operational power. The main power is available to all components in the television apparatus 10.

In the second mode of operation, if the external power supply is still available, even though the main power supply 101 does not generate the main power, the standby power supply 102 should continue to supply the standby power. However, the standby power is only available to the controller 100 and the IR receiver 110, so that the controller 100 can detect a power-on or power-toggle control signal from the remote control unit 115 or the local keyboard 105, and turns on a switch (not shown) to connect the main power

supply 101 to the external source, in effect, turning on the television apparatus 10. The standby power is not available to audio switch 140 and other circuitries. The audio switch 140 is a switch that is unable to connect an input to an output when the operational power is not available. For example, 5 the audio switch 140 may be an electronic switch, including, for example, CMOS transistors, such as part CD4066 made by Texas Instruments. Without the operational power, an electronic switch should not be able to connect an input to an output.

When the external power is not available (for example, the television 10 apparatus 10 is unplugged), both main and standby powers are not available, and the audio switch 140 is again unable to connect an input signal to its output.

As such, in the second mode of operation, the audio switch 140 cannot connect an input to the output. However, since one or more of the AUX1, 15 AUX2, and AUX3 inputs are coupled to the inputs of the second audio switch arrangement 180, one of the signals from AUX1, AUX2, and AUX3 is selected, even if the main power and/or the standby power are not available, according to the principles of the invention.

FIG. 3 illustrates an embodiment of the second audio switch 20 arrangement 180, which includes an electromechanical switch 310, illustratively a solenoid switch or a relay. The electromechanical switch 310 includes a solenoid 315, which when charged, connects an input terminal 312 to an output terminal 311, and when discharged, connects an input terminal 313 to the output terminal 311. The input terminal 312, the input terminal 313, 25 and the output terminal 311 are illustratively coupled to the output of the audio switch 140, the AUX1 input, and an input of the hi-fi amplifier 15.

The solenoid 315 receives operational power from the main power supply 101, where a resistor 310 and a diode 302 are added to protect the electromechanical switch 310 and the main power supply 101. The resistor 301 symbolizes the residuary load of the apparatus. 30

In operation, if the main power supply 101 is operating, i.e., in the first mode of operation, the solenoid 315 is charged, forcing the electromechanical switch 310 to connect the input terminal 312 and the output terminal 311, in effect, connecting the audio signal from the audio switch 140 to the hi-fi

amplifier 15. If the main power supply is not operating, i.e., in the second mode, the solenoid is not charged and the switch 310 connects the input terminal 313 to the output terminal 311, in effect, connecting the audio signal from the AUX1 input to the hi-fi amplifier 15 even though the television  
5 apparatus may be in a standby mode where the standby power is available or in a power-off mode where no standby power is available, for example, when the television apparatus 10 is unplugged.

Although AUX1 is illustratively coupled to the second switch arrangement 180, any one of the AUX inputs can be selected for coupling to  
10 the second audio switch arrangement 180.

FIG. 4 illustrates another embodiment of the second audio switch arrangement 180 that can achieve the same effect as the one shown in FIG. 3, when the standby power supply 102 is operating. In this embodiment, a solid state switch 410 is used but other electronic switches can be used as  
15 well. An example of a solid state switch that can be used in this embodiment is a 2:1 analog multiplexer, for example, part SN74AUC2G53 from Texas Instruments, Dallas Texas, USA. This kind of solid state switches has an operating power input and a control input. It may also include an inhibiting input, which should be set low in normal working condition. Responding to  
20 low and high signal levels provided to the control input, the switch 410 respectively connects the input terminal 412 and the input terminal 413 to the output terminal 411. However, when operating power is not available to the operating power input, the switch 410 does not connect an input to the output terminal 411.

25 In this embodiment, both main and standby power supplies 101 and 102 provides power to the operating power input of the switch 410 through respective diodes 403 and 404. The diodes 403 and 404 prevent current from flowing back to the main and auxiliary power supplies 101 and 102 for protecting these two power supplies. The main power supply 101 also  
30 supplies the control signal to the control input of the switch 410. The pull down resistor 406 is responsible to provide a defined low signal level when the main power supply is turned off. If the main power supply 101 has a low impedance control signal output, no pull down resistor is needed.



In operation, if both the main power supply 101 and the standby power supply 102 are operating, i.e., in the first mode, the switch arrangement 180 connects the output of the audio switch 140 to an input of the hi-fi amplifier 15. If the main power supply 101 is not operating, i.e., in the second mode, but  
5 the standby power supply 102 is operating, the switch arrangement 180 connects the audio signal from the AUX1 input to an input of the hi-fi amplifier 15. However, if both the main power supply 101 and the standby power supply 102 are not operational, the switch arrangement 180 does not connect any input audio signal to the hi-fi amplifier 15. Thus, if a user turns off the  
10 television apparatus 10 and leave the television apparatus 10 plugged, the user should be able to enjoy the audio feature from a pre-wired one of the three auxiliary audio inputs, but if the user disconnects the external power source from the television apparatus 10, the user should not be able to listen to the audio from the pre-wired auxiliary audio input.

15 FIG. 5 illustrates another embodiment of the second switch arrangement 180, where all auxiliary inputs are coupled to the switch arrangement 180. The switch arrangement 180 in this embodiment includes four switches 510, 520, 530, and 540, each having an output terminal coupled to an input of the hi-fi amplifier 15, and having an input terminal. The input  
20 terminals of the four switches are respectively coupled to the output for the audio switch 140, AUX1, AUX2, and AUX 3. The four switches receive necessary power from a switch control 505, which also receives the switch control signals  $C_0$  and  $C_1$  from the controller 100, and power from both the main power supply 101 and the standby power supply 102. Instead of sharing  
25 the same switch control signals  $C_0$  and  $C_1$  with the audio switch 140, the second switch arrangement 180 may be controlled by a separate set of control signals from the controller 100 or another controller (not shown).

In operation, when the main power is available, the switch control 505 supplies necessary power to close the switch 510, but no power to the other  
30 three switches regardless of the state of the control signals  $C_0$  and  $C_1$ , leaving the other three switches not in a close position. As a result, the switch arrangement 180 connects the output from the audio switch 140 to an input terminal of the hi-fi amplifier 15.

When the main power is not available but the standby power is available, the switch control supplies necessary power to one of the four switches according to the state of the control signals  $C_0$  and  $C_1$ . For example, if  $C_1$  and  $C_0$  are both caused to be at a low signal level (i.e. binary 00), then the switch control 505 supplies power to the switch 510, connecting the output from the audio switch 140 to the hi-fi amplifier 15. Of course, in this case, no audio signal is coming from the output of the audio switch 140, because the main power is not available to operate the audio switch 140. If  $C_1$  is low and  $C_0$  high (binary 01), then the switch control 505 supplies power to operate the switch 520 connecting AUX1 to hi-fi amplifier 15. If  $C_1$  is high and  $C_0$  low (binary 10), then the switch control 505 supplies power to operate the switch 530 connecting AUX2 to hi-fi amplifier 15. If both  $C_1$  and  $C_0$  are high (binary 11), the switch control 505 supplies power to operate the switch 540, connecting AUX3 to hi-fi amplifier 15.

The switch control 505 can be illustratively implemented using digital logic, for example, using a field programmable logic array.

Note that if both the main power and the standby power are not available and if solid state switches such as the one shown in FIG. 4 are used, the switch arrangement 180 does not connect any input signal to the hi-fi amplifier 15. An exemplary electronic switch package that can be used in this embodiment is a CD4066 CMOS quad bilateral switch made by Texas Instruments, Dallas, Texas, USA. However, if electromechanical switches such as the one shown in FIG. 3 are used, a pre-defined one of the four switches can be made in a close position and other three in an open position when both main and standby powers are not available.

The desired input to be selected when the main power is not available can be saved in a non-volatile memory, such as an electrically erasable programmable read only memory (EEPROM). When the processor detects that the television apparatus 10 is in the second mode, the processor 100 also retrieves the setting from the memory and generates necessary control signals to close the corresponding switch. The setting can be preset in a factory and saved in the memory. The setting can be unchangeable by a user or changeable by a user through a user interface such as OSD (On-Screen Display) menu using the remote unit 115 or the local keyboard 105. As an

alternative, the controller 100 can simply receives control commands from the remote control unit 100 or the local keyboard 105 to dynamically select the audio input desired by the user.

All the examples discussed above have a common advantage: the television apparatus 10 is similar to a conventional television apparatus, except that the second audio switch arrangement 180 and the associated interface circuits are added. As such, the existing circuits in a television apparatus do not have to be modified. If modifying the existing circuits is not a concern, the second audio switch arrangement 180 may be eliminated, simply by supplying the standby power to the audio switch 140, so that the audio switch 140 is still operative when the main power is not available. An example of such an arrangement is shown in FIG. 6, where the audio switch 140, like the processor (shown as a microprocessor) 100, receives both the main power and the standby power. Also shown in FIG. 6 is an EEPROM 103 to be used for predefining which audio input to be selected when the main power is not available, as described earlier. The AUX1, AUX 2, and AUX3 inputs are illustratively connected to a DVD player, a set-top box, and an auxiliary audio/video apparatus in FIG. 6. In this embodiment, the audio switch 140 may use a similar switch arrangement shown in FIG. 5.

As described herein, the present invention provides an audio/video apparatus having audio switch arrangement that can connect an audio input to an audio output of the audio/video apparatus, even if the audio/video apparatus is in standby mode or has the external power supply disconnected. The audio/video apparatus illustratively is a television apparatus having a display, but it can be applicable to television apparatus without a integrated display, but having one auxiliary audio input and a tuner for receiving a broadcast signal, or two or more auxiliary audio inputs, such as set-top boxes, video cassette recorders (VCRs), DVD players, video game boxes, personal video recorders (PVRs), computers or other apparatuses that may not include an integrated display device.

While this invention has been described as having a preferred design, the present invention can be further modified within the spirit and scope of this disclosure. This application is therefore intended to cover any variations, uses, or adaptations of the invention using its general principles. Further, this

application is intended to cover such departures from the present disclosure as come within known or customary practice in the art to which this invention pertains and which fall within the limits of the appended claims.